

MINUTES
OF
THE UTAH RADIATION CONTROL BOARD
September 10, 2004
Department of Environmental Quality (Bldg. #2)
Conference Room 101
168 North 1950 West
Salt Lake City, Utah 84114-4250

BOARD MEMBERS PRESENT

Karen S. Langley, M.S., Chair
Stephen T. Nelson, Ph.D., Vice Chair
Dianne R. Nielson, Ph.D., Director of DEQ
Dane Finerfrock, Executive Secretary
Keith C. Barnes, J.D.
Kent J. Bradford, P.G.
Linda M. Kruse, M.S.
Gregory G. Oman, D.D.S., B.S.
Robert S. Pattison, B.S.
Dan L. Perry, B.S.
John W. Thomson, M.D.
Gene D. White, Commissioner

BOARD MEMBERS ABSENT/EXCUSED

Joseph K. Minor, M.D.
Rod O. Julander, Ph.D.

DRC STAFF/OTHER DEQ MEMBERS PRESENT

Gwyn Galloway, DRC Staff
Craig Jones, DRC Staff
Loren B. Morton, DRC Staff
Fred Nelson, Attorney, DEQ/Atty Gen's Ofc
Ray Nelson, DRC Staff
Yoli Shropshire, DRC Staff

PUBLIC

Paul E. Christian, University of Utah
Dave Frydenlund, Intern'l Uranium (USA)
Corporation (IUC)
Jason Groenewold, HEAL Utah
Mark Ledoux, Envirocare of Utah, Inc.
Tye Rogers, Envirocare of Utah, Inc

GREETINGS/MEETING CALLED TO ORDER

The Utah Radiation Control Board convened in the DEQ Building #2, Room 101, 168 North 1950 West, in Salt Lake City, Utah. Karen S. Langley, Chair to the Board, called the meeting to order at 2:00 p.m. She welcomed the Board members and the public in attendance at the meeting. Karen Langley indicated that if the public wished to address any items on the agenda to sign the public sign-in sheet. Those desiring to comment would be given an opportunity to address their concerns during the comment period.

I. APPROVAL OF MINUTES (Board Action Item)

a. Approval of August 6, 2004 Minutes

Karen Langley, Chair, asked the Board Members for any corrections to the minutes of August 6, 2004. She proposed the following changes to the Minutes:

1. Page 2, Item IV.a., under subtitle "Approval of Certified Mammography Imaging Medical Physicist," first paragraph, first sentence which reads "Craig W. Jones, Manager, informed the Board that Gene L. Wollen, a medical physicist employed by **North Physics Northwest, . . .**" **Change to read Health Physics Northwest . . .**"
2. Page 4, Item V. a., under subtitle "Concurrence with the Plan to Split Groundwater Samples Collected at Envirocare of Utah, Inc." Chairwoman Langley proposed that this paragraph be revised by Loren Morton to quote the actual percentage and number of wells tested at Hanford, Washington and Barnwell. Loren Morton will revise the paragraph as follows:

"There were no published guidelines from other government agencies for precedent/guidance available to the Division; however, the DRC found some relevant analogs. One of the technical-literature analogs provided some guidance about duplicate sampling at a five (5%) percent rate. The Division also considered the information provided to the Division from the Auditors (the Auditors did some investigation of their own). It is as follows: **Hanford, Washington, with a total of seven (7) monitoring wells collects split samples at frequencies of about 36% per year. Barnwell with a total of more than 100 monitoring wells, collects split samples at a frequency of ten percent (10%) per year.** From this information, the Division determined a ten percent (10%) rate would be appropriate. Consequently, the Division has proposed a ten percent (10%) rate in its draft plan."

MOTION MADE BY GREGORY G. OMAN TO APPROVE THE MINUTES OF AUGUST 6, 2004, AS CORRECTED, SECONDED BY DAN L. PERRY.

MOTION CARRIED AND APPROVED UNANIMOUSLY

II. RULES
No Items

III. RADIOACTIVE MATERIALS LICENSING/INSPECTION (Board Information Item)

A-1. PET and CT Introduction – Gwyn Galloway

Gwyn Galloway said Positron Emission Tomography and Computed Tomography were two beneficial diagnostic modalities used by physicians:

- (1) PET, Positron Emission Tomography, uses radioisotopes, and it is a nuclear medicine scan.
- (2) CT, Computed Tomography, is machine-produced radiation.

PET and CT provide physicians with different information. The PET scan gives metabolic information and can give information on “uptake.” PET, however, does not allow the physician to visualize the actual location of a small tumor. Computed Tomography provides physicians with detailed anatomical information, but it does not provide the metabolic information that a PET scan can provide. In the past, physicians have tried to fuse the PET and CT images together using software, but it was not successful. Now there is technology available that can combine the two modalities together. It is called “Fusion Imaging

The Division has certain regulatory roles for both the PET and CT modalities and also for the combined modality of “Fusion Imaging.” The DRC regulates both radioisotopes and machine-produced radiation. The DRC licenses and inspects the cyclotron that is used to produce the radioisotopes used for PET scans. The DRC also licenses and inspects the manufacturing and distribution of the radioisotope. The Division licenses and inspects each individual clinic or hospital that would use the radioisotope--the end users. In addition, the DRC registers CT machines and inspects facilities that use CT machines.

The authority for licensure of the physicians and operators using these modalities does not rest with the Division. It rests in the Department of Commerce in the Division of Occupational and Professional Licensure. They license physicians, radiological-technicians, and nuclear-medicine technicians. However, for combined PET/CT or “Fusion Imaging,” there is no licensure to authorize one specific person to operate the “Fusion Imaging” unit. Paul Christians, from the University of Utah, will discuss the professional societies and movements to help with “Fusion Imaging” licensure. Gwyn said she had provided an overview of the DRC's regulatory role, and she asked the Board Members, if they had questions.

Comments by the Board:

Karen Langley, Chair, said the Division faced the challenge of licensing individuals to operate the “Fusion Imaging” machines, and the Division must continue to monitor these “types of changes” in technology. She said the licensing changes for “Fusion Imaging” would be coming through the legislature. Karen said that, currently, the Division was attempting to “bridge” the regulatory difficulties and encourage the Legislative Office to address new technologies. Professional societies are making an effort to correct the licensing gaps without violating federal and state rules and regulations. They are also trying to correct the possibility of “hand-stringing” the “Fusion Imaging” technology and making the approved-operation of the equipment too difficult to perform. Additionally, since there is no license category for the individuals operating the “Fusion Imaging,” the technician will be operating outside the licensing hazards. The Division has the ability to move forward and deal with these technologies. The Division must also educate its Board. It is a new challenge.

A-2. The Status of PET and CT -- Paul E. Christian

Paul E. Christian is the Director of the Cyclotron Radio Industry Laboratory, and he is a Clinical Physicist for the PET/CT Imaging Machines and of Nuclear Medicine at the University of Utah’s Huntsman Cancer Research Institute. Paul Christian said he had been at the University of Utah for 30 years, and he has obtained PET technology for the Huntsman Cancer Research Institute. He said that PET technology is established in the State of Utah, and it is spreading rapidly. He said he is involved in PET technology at the national level and he is currently involved in writing the PET certification exam. Paul said that he is on the “Committee for Immerging Technologies,” and the committee will be determining how to deal with the issues presented by new technological advancements. He said he would try to compress a two-hour presentation (given by various people) into 15 minutes.

The following outline was presented to the Board by Paul E. Christian: (a copy of Paul Christian’s presentation is attached).

- (1) Combined, PET/CT Technology
 - a. Technology
 - b. Professional Organization Activities
 - c. Operator Issues
 - d. Regulatory Issues
- (2) Rational: Number of Operators in US
 - (a) 5,000 NMT/RT in US
 - (b) 200 NMT/CT

- (c) Insufficient workforce to mandated dual credentialing
- (3) Consensus Statement 1 and 2
 - (a) Personnel Qualified to Operate PET/CT
 - (b) Regulation of Personnel Who Operate PET/CT
 - (c) Establish Pathways for Operators To Become Competent in PET/CT
 - (d) Reality Check: 38 states license RT; 28 states license RTT; 21 states license NMT; and no states require CT Certification
 - (e) Progress in Addressing PET/CT Needs:
 - (1) Education Issues: PET is becoming Mainstream. New education essential's state that PET must be included in entry-level curriculum
 - (2) Certification Issues: the first PET specialty exam is being developed by September 18, 2004
 - (3) Regulatory Issues: State Model Licensure Bill, PET/CT Consensus Paper, PET Curriculum

IV. X-RAY REGISTRATION/INSPECTION
No Items

V. RADIOACTIVE WASTE DISPOSAL (Board Information item)

a. Concurrence with the "Groundwater Split Sampling Policy at Envirocare of Utah, Inc." – Loren B. Morton

Loren Morton, Section Manager, said three changes to the Draft Policy were requested by the Board. He said the revisions had been completed by the Division. They are as follows:

ENVIROCARE SPLIT SAMPLING POLICY CHANGES:

- (1) Identify the Quality Assurance procedures to be used by the Division staff for split sampling.
- (2) Define the amount of the acceptable variance between DRC laboratory results and Envirocare of Utah's laboratory results.
- (3) Provide additional discussion in the policy on to how "unacceptable variance" will be resolved.

Loren Morton discussed the revised Draft Policy with the Board Members. He asked the Board Members if they had any questions or comments:

Comments by the Board:

Stephen Nelson, Vice Chair, said the Division had certainly provided the “kind of detail” that he was looking for in the revision. He commended Loren for his efforts on the revision. Steve recommended, however, that if the Division had problems with a laboratory, the Division should consider changing laboratories--and, he said that “changing laboratories” would be an obvious solution.

Karen Langley, Chair, asked the Board to consider whether it concurred and approved the Division’s revised strategy on the “Groundwater Split Sampling Policy at Envirocare of Utah, Inc.”

Public Speaker

Jason Groenewald, HEAL Utah, suggested three revisions to the “Draft Policy” as follows:

- (1) The Time Delay: Jason Groenewald said the “follow-up,” split sampling event would not occur until next year. He felt “next year” was too long of a time frame.

Loren suggested that on page 5, sentence 4 of the Policy, which reads “. . . during the next scheduled sampling event . . .” **Change to read** “. . .during the next **Envirocare** scheduled sampling event . . .”

No Motion was made by the Board to implement this suggested change.

- (2) Percent of Split Sampling: Jason Groenewald asked for the percentage of wells sampled each year “by Policy” to be increased to shorten the “sampling, return period.”

No motion was made by the Board to implement any such change.

- (3) Exceedences: Jason Groenewald asked if the DRC would investigate excess, laboratory concentrations by doing their own split sampling?

Loren responded that increased, split sampling was already part of the Policy. He said the DRC would immediately schedule another split sampling event, if an exceedence occurred. He said it was included in the last paragraph of the "Corrective Action."

Stephen Nelson, Vice Chair, said that he viewed “split sampling” to be a quality control measure, rather than a duplicate, analytical procedure.

**MOTION MADE BY DAN L. PERRY FOR CONCURRENCE
WITH THE “GROUND WATER SPLIT SAMPLING POLICY AT
ENVIROCARE OF UTAH, INC.,” AS REVISED AND PRESENTED
BY LOREN MORTON, SECONDED BY KENT C. BRADFORD.**

MOTION CARRIED AND APPROVED UNANIMOUSLY

(The Final Version of the Policy, Dated September 17, 2004, is Attached)

VI. URANIUM MILL TAILINGS UPDATE (Board Information item)

a. Agreement State Program – Dane L. Finerfrock

Dane Finerfrock, Executive Secretary, informed the Board that on August 16, 2004, Governor Olene S. Walker signed the Agreement from the U.S. Nuclear Regulatory Commission for the State of Utah. Utah is now an Agreement State for four licensees. The Division has received 40 boxes of paperwork, twelve CDs containing correspondence, and other additional paperwork. The DRC staff are currently organizing and “sorting through” the boxes.

The Division is also in the process of converting the U.S. Nuclear Regulatory Commission’s (NRC) licenses into Utah licenses. Consequently, the Division staff will be changing the format of the licenses, and a distinctive Utah license number will be assigned to each licensee. The DRC is in the process of asking the licensee’s to change the beneficiaries on the funding mechanism for funding the standby trust. The Executive Secretary of the Radiation Control Board will become the beneficiary of the trusts. The Division has notified the licensees of the fee schedule.

COMMENTS FROM THE BOARD

Dan Perry asked Dane for the identity of the 4 facilities.

Dane said the 4 facilities were as follows:

Active Licensees

- (1) Envirocare of Utah, Inc.
- (2) International Uranium (USA) Corporation

Decommissioning Licensees

- (3) Rio Algom Mining
- (4) Plateau Resources Limited

Dane said that Rio Algom Mining was “further along the path” of closure than Plateau Resources Limited: however, he said both facilities are licensees, until the licenses have been transferred to the U.S. The Department of Energy for perpetual care. When the NRC “turned over” the licenses to the DRC there was a backlog of work that the NRC had not “picked-up,” anticipating the transfer of authority. The DRC is currently organizing and prioritizing the backlog and “putting together” an inspection schedule for the two active licensees.

Comments by the Board:

Kent Bradford asked if the Division would be hiring new staff for this area. Dane responded that the new staff were “already on board,” and working on the new licenses.

VII. OTHER DIVISION ISSUES (Board information item)

**a. Board Membership Reappointments and New Board Member -
Dane L. Finerforck**

Dane Finerfrock, Executive Secretary, said that Board Members “up for reappointment” should have received a letter from Governor Olene S. Walker. Dane announced the reappointments as follows:

- (1) Kent J. Bradford, P.G.
- (2) Stephen T. Nelson, Ph.D., Vice Chair
- (3) Gregory G. Oman, D.D.S., B.S
- (4) Robert S. Pattison, B.S.
- (5) Dan L. Perry, B.S.

Another appointment was made for:

- (6) Joseph K. Miner, M.D.

Dane said that Dr. Joseph Miner would replace Gary Edwards and would represent Local Health. Dr. Miner is the Director of the Utah County Health Department. He said that Dr. Miner could not be in attendance, due to a previously scheduled appointment; however, he would be in attendance at the next Board Meeting.

VIII. PUBLIC COMMENT

Jason Groenewold, HEAL Utah

IX. OTHER ISSUES

**Next Board Meeting – November 5, 2004, DEQ Bldg #2, Conference Room
101, 168 N 1950 West, Salt Lake City, Utah from 2:00 – 4:00 P.M.**

THE BOARD MEETING ADJOURNED AT 3:35 P.M.

UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY DIVISION OF RADIATION CONTROL GUIDANCE DOCUMENT FOR COLLECTING SPLIT SAMPLES FROM GROUNDWATER MONITORING WELLS AT THE ENVIROCARE OF UTAH, INC. LOW-LEVEL RADIOACTIVE WASTE, MIXED WASTE AND 11e.(2) WASTE DISPOSAL FACILITY

The purpose of this guidance document is to define the policy that will be followed by Utah Department of Environmental Quality (DEQ) Division of Radiation Control (DRC) personnel in conducting split groundwater samples at the Envirocare of Utah, Inc. (Envirocare) Clive, Utah low-level radioactive waste and 11e.(2) waste disposal facility.

INTRODUCTION

The Envirocare waste disposal facility operates under Ground Water Quality Discharge Permit No. UGW450005 (Permit); which is managed by the DRC under authority of the DEQ Division of Water Quality (DWQ). The Permit is the primary tool used by DRC to protect groundwater quality at the site and requires Envirocare to install, maintain, and regularly sample a monitoring well network to determine performance of the various disposal operations. Currently, waste is placed in the Class A, Low-Activity Radioactive Waste (LARW), Mixed Waste, and 11e.(2) waste disposal cells, as well as several wastewater disposal ponds. Permit requirements include details such as the number and location of groundwater monitoring wells, sampling frequency, sampling analyte list, and protection levels for each monitoring well. The Permit also requires Envirocare to ensure the quality of groundwater sampling and analysis through use of an approved Quality Assurance Plan (QAP). The QAP specifies the sample collection and handling techniques that must be followed, laboratory analytical methods, type and number of quality control samples that must be collected, internal laboratory quality control requirements and analytical acceptance limits, analytical detection levels, etc.

As part of the groundwater protection program, the DRC periodically collects duplicate or split groundwater samples for independent laboratory analysis. When conducting split sampling, DRC personnel accompany the Envirocare groundwater sampling team during a regularly scheduled sampling event and collect groundwater samples from the same wells at the same time as the Envirocare staff. This process ensures that the samples are collected under identical conditions (season of year, time of day, weather conditions, well purge technique and volume, etc.) to minimize the variables between samples collected by the DRC and Envirocare.

OBJECTIVE OF COLLECTING SPLIT SAMPLES

The primary objective for the DRC split sampling program is to verify that the data being collected and reported by Envirocare are accurate and representative of groundwater conditions at the site. This is achieved through the following tasks:

- **observing and verifying that appropriate field sampling methods are employed by Envirocare, and thereby verify collection of reliable and accurate field data,**
- **verifying the laboratory analytical results reported by Envirocare through independent laboratory analysis of the split samples and data comparison, and**
- **ensuring sample validity.**

Each task is described in further detail below.

Field Sampling Methods. When accompanying Envirocare groundwater sampling staff during a split sampling event, DRC personnel have the opportunity to observe their routine sampling practices. DRC staff can verify the monitoring wells are in operable condition, and determine if sample collection tasks such as water level measurements, purge volume calculations, purge rates, sample collection sequence, sample preservation and handling techniques, etc. are in accordance with Permit requirements.

Laboratory Analytical Results. DRC submits their split samples to an analytical laboratory that is independent of Envirocare's laboratory. This provides the opportunity to compare the results between the differing laboratories. Since the samples have been collected under the same field conditions, discrepancies in the results are primarily indicative of sample handling, preparation, and laboratory analytical techniques. A certain amount of variance in results obtained by each laboratory is normal and expected. However, if the variance is outside of acceptable limits, further investigation is warranted to determine the source of the discrepancy. If the discrepancy cannot be resolved, the analytical result may be disqualified, and/or the Permittee may be required to resample or reanalyze.

Sample Validity. Collecting split samples and verifying the independent analytical results allows the DRC to ensure sample validity. This process allows detection of errors that can arise both in the field (e.g. sample mislabeling) and in the laboratory (e.g. erroneous methods, detection limits, etc.) and promotes diligence on the part of the Permittee to provide proper attention and quality control in their groundwater monitoring program.

SPLIT SAMPLING FREQUENCY

DRC policy is to conduct split sampling of groundwater monitoring wells at the Envirocare facility on an annual basis. Consistent with other oversight activities performed by DRC at the Envirocare facility, each split sampling event is performed as a groundwater inspection module.

In accordance with industry standards, duplicate samples are typically collected from at least 5% of the sample set^{1,2} (monitoring wells). To ensure the DRC split sampling program is rigorous and consistent with other low-level radioactive waste disposal sites³, split samples will be collected from 10% of all monitoring wells at the Envirocare facility.

MONITORING WELL SELECTION/RETURN SAMPLING INTERVAL

A different set of Envirocare monitoring wells will be chosen for split sampling annually. As a result, each well will be sampled at least once during a 10-year period (10-year maximum return interval). Individual wells may be sampled more than once within any given 10-year period in response to technical or regulatory needs as determined by DRC staff.

Selecting a different set of wells each year ensures that Envirocare and their laboratory are subjected to the DRC sample validation process over the entire range of groundwater hydrology and chemistry conditions at the site.

ANALYTE SELECTION

DRC split samples will be collected and analyzed for the same analyte list as those collected by Envirocare, in compliance with Permit requirements. However, in consultation with DRC management, the analyte list may be adjusted in response to special technical or regulatory needs.

FIELD AND LABORATORY QUALITY ASSURANCE

To help ensure comparability between the Envirocare samples and DRC split samples, all field and laboratory methods utilized by DRC will satisfy the same quality assurance criteria as followed by Envirocare. To achieve this end, the currently approved Quality Assurance Plan (QAP) used by Envirocare will be provided to the laboratory analyzing the DRC split samples as a guidance document to be followed in analysis of the DRC samples.

LABORATORY SUPPORT

In order to facilitate a timely comparison of the split sample data and timely correction of sampling or analytical errors that may be identified, it is important to receive the laboratory results as quickly as possible. To achieve this goal, DRC split

sampling staff will require the laboratory to turn-around results within 45 days of sample receipt. In the event that the State Health Laboratory cannot meet the 45-day deadline, another laboratory will be contracted to perform analytical services. If use of an outside laboratory results in increased resources needed to conduct the split sampling event, the DRC will immediately request those resources from DEQ.

DRC DATA EVALUATION

In order to facilitate facility compliance and timely correction of sampling or analytical errors that may be identified, it is important to review and evaluate the split sampling results as soon as possible. To this end, DRC staff will complete their review of the split sampling data and prepare a written report for management approval within 45 days of receipt of the Envirocare Semi-Annual Groundwater Monitoring Report.

Data Validation

Upon receipt of laboratory analytical results from the DRC split samples, DRC staff will validate the data to determine its usability prior to comparing it against Envirocare's sample results. Validation of the DRC data will consist of verifying analysis within holding times, appropriate analytical methods used, adequate detection limits, laboratory control samples (e.g., blind duplicates, field blanks, etc.) were within limits specified in the QAP, etc.

Data Comparison-Non Radiological Parameters

Comparability of the Envirocare and DRC laboratory results for non-radiologies will be determined by calculating the Relative Percent Difference (RPD) between two split samples using the following equation:

$$RPD = \{|S1 - S2| / [(S1 + S2) / 2]\} \times 100\%$$

Where: S1 = original sample (Envirocare), and
S2 = duplicate sample (DRC)

EPA guidelines established for evaluating contract laboratories has set a criterion of 20% RPD (or less) as acceptable⁴. However, the 20% RPD criterion has been established for duplicate samples being analyzed by the *same* laboratory. There are many more variables when there is another laboratory involved, and consequently the variability between the two samples will be greater. Unfortunately, RPD criteria are not available for this scenario⁵. Precedent established by another Division in DEQ allows a 30% RPD when comparing split sampling data between two separate laboratories⁶. Using this as a basis for the Envirocare split samples, an RPD of 30% or less will be acceptable, and no further evaluation will be required. When the RPD is greater than 30%, corrective action will be required.

Data Comparison- Radiological Parameters

Comparability of results between the Envirocare and DRC laboratories for radiologic contaminants will be evaluated using the reported values and the range of their respective error terms as follows:

Bounds of the 95% confidence limit:	Lower Bound		Upper Bound
Envirocare Sample Result =	S1 – T1	to	S1 + T1
DRC Split Sample Result =	S2 – T2	to	S2 + T2

**Where: S1 = original sample result (Envirocare), and
S2 = duplicate sample result (DRC)
T1 = reported error term of Envirocare sample
T2 = reported error term of DRC sample**

If the reported concentration ranges from each laboratory overlap, the results will be considered comparable, and no further evaluation will be required. If the reported ranges do not overlap, corrective action will be required.

Corrective Action

In an effort to determine the source of a discrepancy between Envirocare and DRC split sample results, the following will be assessed, in order, until a resolution of the discrepancy is reached:

- 1) Both laboratories will be asked to check for a data transcription error in reported results.**
- 2) DRC staff will verify each laboratory (Envirocare and DRC) met all quality control criteria as defined in the QAP.**
- 3) If the holding time of the contaminant has not been exceeded, both labs will be asked to re-analyze the samples in question.**
- 4) If the holding time has been exceeded, DRC staff will repeat the split sampling of the well(s) and analyte(s) in question during the next scheduled sampling event and the situation re-evaluated later.**
- 5) If the discrepancy is repeated for any given monitoring well and analyte for two consecutive split sampling episodes, DRC staff will report the discrepancy to the Utah State Health Laboratory Bureau of Laboratory Improvement (BLI) for investigation. The BLI certifies laboratories that analyze samples for compliance purposes under DEQ rules (Utah Administrative Code R444-14). Part of this certification process includes standards established by the National Environmental Laboratory Accreditation Conference (NELAC). Since both the Envirocare and DRC laboratories must have the State certification, failure to perform up to standards enforced by BLI could result in loss of accreditation, or civil and/or criminal penalties for one or both laboratories.**

UNFORESEEN CONDITIONS

Guidance presented herein represents the *minimum* routine monitoring that will be conducted, but does not exclude professional judgment by DRC staff which could include collecting additional samples. Therefore, this guidance shall not limit the DRC staff's ability to act on exigent conditions, or investigate anomalous results in the planning of any split sampling event at the Envirocare facility.

References

¹ *Standard Methods for the Examination of Water and Wastewater*, 20th Edition, 1998. American Public Health Association, American Water Works Association, Water Environment Federation. Washington, D.C. p. 1-7

² United States Environmental Protection Agency, et al., 1997. Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), EPA 402-R-97-016. Washington, D.C. December 1997 (Final). p. 4-34.

³ **10% annual split sampling rate by the State of South Carolina at Barnwell ChemNuclear low-level radioactive waste disposal site. Dane Finerfrock, 2004 personal communication with Henry Porter of South Carolina Department of Health and Environmental Control, Assistant Director Division of Waste Management Bureau of Land Waste and Management, July 2004.**

⁴ United States Environmental Protection Agency, 2002. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, EPA 540-R-01-008. Washington, D.C. July 2002 (Final). p. 25.

⁵ United States Environmental Protection Agency, 2002. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, EPA 540-R-01-008. Washington, D.C. July 2002 (Final). p. 34.

⁶ Utah Division of Solid and Hazardous Waste, personal communication with Mr. Don Verbica, August 25, 2004.